above. Claims 1-25 and 31-34 are pending. Claim 21 has been amended and claims 31-34 have been added.

Claim Rejections – 35 USC § 103

Claim 1 was rejected under 35 U.S.C. 103(a) as being unpatentable over Phillips et al. (4,894,709). The Office Action asserts that Phillips discloses all of the claimed limitations, except the first layer being a polymeric material, and that it would have been obvious design choice to substitute polymeric material in place of the materials of Phillips to achieve a microcircuit compatible heat sink.

Not only does Phillips fail to disclose a first layer of polymeric material, but also a first layer of polymeric "film" material. Instead, Phillips discloses the use of silicon substrates into which microchannels are formed by precision sawing or orientation-dependent etching to produce heat sinks for use with microcircuits. Other materials specified include gallium arsenide, germanium, indium phosphide, aluminum, copper and silver. (Col. 11, Lines 58-61). There is no recognition of or suggestion for using polymeric materials as an acceptable material for formation of the heat sinks in Phillips, let alone the use of a polymeric film material. The fact that Phillips noted that its invention was useful on a number of ceramics and metals shows that it was not obvious to Phillips that its invention was useful for a third primary material choice, polymers. Further, the formation methods mentioned are limited to precision machining and etching, which are noted not conducive to polymeric films used to construct microchanneled heat exchangers, but are rather more appropriately used with the materials listed in Phillips. Substitution of a material incompatible with the teachings of the reference would not have been a matter of obvious design choice, and therefore Phillips does not render claim 1 unpatentable.

Claims 1 and 21-23 were rejected under 35 U.S.C. 103(a) as being unpatentable over Bae (5,771,964). The Office Action asserts that Bae also discloses all of the claimed limitations, except the first layer being polymeric material, and that it would have been obvious design choice to substitute polymeric material in place of the materials of Bae to achieve the described heat exchanger.

Not only does Bae fail to disclose a first layer of polymeric material, but also a first layer of polymeric "film" material. Instead, Bae discloses the use of metal, such as aluminum or copper, to form the heat exchanger tubes. (Col. 4, Lines 50-51). Heat transfer from a fluid inside the tube to a fluid outside the tube occurs through the heat conductive tube walls as the internal fluid flows along the channels. (Col. 6, Lines 13-16). Once again, there is no disclosure of or suggestion to use a polymeric film material to form the tubes for the heat exchanger of Bae. On the contrary, the heat exchanger further includes metal serpentine fins that are brazed to adjacent flat tubes and supported by these tubes. (Col. 4, Lines 56-59). Further, substituting Bae's metal with a polymeric material which is generally understood to be thermally insulting rather than thermally conductive is unobvious for a heat exchanger application. Thus, it is clear that substitution of a polymeric film material for the metal of Bae is neither contemplated or suggested, and such substitution would not have been a matter of obvious design choice in light of the teachings of Bae. In fact, Bae appears to teach away from such a material choice for the tubes by the structural requirements imposed by the overall heat exchanger. Therefore, Bae does not render claims 1 and 21-23 unpatentable.

Claims 1-5, 9-10 and 12-20 were rejected under 35 U.S.C. 103(a) as being unpatentable over Rosman et al. (4,347,896) in veiw of Bae. The Office Action asserts that Rosman fails to teach the claimed size limitations, but that the heat exchanger of Bae teaches these size limitations, thus it would have been obvious to produce the heat exchanger of Rosman within the size limitations as taught by Bae.

Not only does Rosman not teach or suggest a heat exchanger having microchannels within the size limitations of the claims, but it also does not teach or suggest a microchanneled heat exchanger formed from a first layer of polymeric film material. Although polymers are mentioned as possible suitable materials for Rosman, no sizing information is provided beyond a general, conclusory statement that reads: "[d]epending upon the ultimate use and the desired heat transfer rate, various plate thickness, channel and fin ratios, length and width ratios and various thermally conductive materials can be used." (Col. 8, Lines 41-44). Such a generalized statement does not provide enablement for or teach or suggest a reasonable likelihood of success to achieve a microchanneled polymeric film

material heat exchanger, in accordance with the claimed invention. In addition, Bae does not overcome the shortcomings of Rosman, because Bae (as stated above) teaches away from a polymeric film material for forming the microchannels of Bae. Therefore, the theoretical combination of Rosman and Bae does not produce the claimed heat exchanger, and thus such a combination does not render the claims unpatentable.

Claims 2-5, 9-10 and 12-20 depend from patentable independent claim 1 and, as such, are allowable for at least the same reasons set forth above. Therefore, Applicants respectfully request withdrawal of the rejection and allowance of these claims.

Claims 14 and 24 were rejected under 35 U.S.C. 103(a) as being unpatentable over Rosman in view of Bae, and in further view of Schubert et al. (5,249,359). Claims 14 and 24 depend from allowable independent claims 1 and 21, respectively, and as such are allowable for at least the same reasons. Therefore, Applicants respectfully request withdrawal of the rejection and allowance of these claims.

New claims 31-34 also depend from allowable claim 1, and thus are patentable for at least the same reasons set forth above. In addition, claim 31 is patentable over the cited art because none of the prior art references teach or suggest, alone or in theoretical combination, a heat exchanger having a microreplicated polymeric film layer. In particular, Phillips requires the precision machining or etching of metal, silicon or other similar materials, Bae requires metals which are not conducive to microreplication, and Rosman does not teach microchannels and only discloses operations such as cutting, brazing and welding in conjunction with formation of its heat exchanger. Therefore, claim 31 is patentable and Applicants respectfully request allowance of this claim.

Claims 33 and 34 are patentable over the cited art because the art does not teach or suggest flexible heat exchangers, especially those having the ability to conform around a mandrel of only 1 centimeter in diameter or more without constricting flow through the passages. On the contrary, the tubes of Bae must be structural supportive of the fins, the heat sink of Phillips is designed for use on a microchip and Rosman describes plate stacks but not flexible designs. Therefore, claims 35 and 36 are patentable and Applicants respectfully request allowance of these claims.

Claim Rejections – 35 USC § 102

Claims 21-23 were rejected under 35 U.S.C. 102(b) as being anticipated by, or in the alternative, under 35 U.S.C. 103(a) as being rendered unpatentable over Rosman. The Office Action asserts that Rosman discloses all of the claimed limitations except a film.

Claim 21 has been amended to include the channel size recitation of claim 1. Therefore, amended claim 21 and its dependent claims is patentable for at least the same reasons set forth above with reference to the Rosman patent. Therefore, Applicants respectfully request withdrawal of these rejections and allowance of these claims.

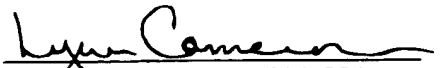
CONCLUSION

All pending claims are now in condition for allowance. A notice to that effect is respectfully requested.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached page is captioned "Version with markings to show changes made."

Respectfully Submitted,

THOMAS I. INSLEY et al.

By: 

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

In the Claims:

The following claim has been amended as shown:

21. (Twice Amended) A method of transferring heat between a heat transfer fluid and another media that is to be thermally effected in proximity to a heat exchanger, comprising the steps of:

(a) providing a heat exchanger comprising a layer of polymeric film material having first and second major surfaces, wherein the first major surface includes a structured surface having a plurality of flow channels that extend from a first point to a second point along the surface of the layer, and that have a minimum aspect ratio of the channel's length to its hydraulic radius of about 10:1 and a hydraulic radius of no greater than about 300 micrometers;

(b) connecting a source of heat exchange fluid having a predetermined initial temperature to flow passages comprised of the flow channels;

(c) placing the heat exchanger in a position to conduct heat between the other media and the fluid within the heat exchanger; and

(d) providing a source of potential over the flow passages of the heat exchanger, and thereby moving the fluid through the flow passages from a first potential to a second potential, the movement of the fluid causing heat transfer between the moving fluid and the other media so as to thermally affect the media in proximity to the heat exchanger.

The following new claims have been added:

31. (New) The heat exchanger of claim 1, wherein the first layer is microreplicated.

32. (New) The heat exchanger of claim 1, wherein the first cover layer is thermally conductive.

33. (New) The heat exchanger of claim 1, wherein the heat exchanger is flexible.

34. (New) The heat exchanger of claim 35, wherein the flexible heat exchanger can conform about a mandrel that has a diameter of at least about one centimeter (about 0.39 inches) without significantly constricting flow through the plurality of flow passages.